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NOTES ON AGRICULTURE IN SOUTHERN CHINA

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The Canton river delta is the center of population and industry of the southern part of the Chinese republic. Lying as it does almost exactly on the tropic of cancer, it is in the borderland between tropical and temperate conditions. As a result of this and of a number of other causes, it is a region of contradictions, not only in vegetation, but in the use of land, in agricultural practices, and in the industries and home life of the people.

The first glimpse of the plant life in Hongkong shows the varied types of growth which characterize the whole delta. This is best studied in the Botanical Gardens, into which Mr. Tutcher, the Superintendent, has gathered a large assortment of plants from many parts of the world. The palms and bamboos are many of them familiar in the Philippines, as are also the ferns, banyans, casuarinas (agoho), and many of the trees. But adjoining these are groves of conifers: *Taxodium distichum* and *Juniperus* from the United States, species of *Araucaria* and *Callitris* from Australia, and the native Chinese pines and species of *Cephalotaxus*. The rhododendrons, salvias, iris, pear and peach trees also remind one that he is only on the edge of the tropics. But the general aspect of the vegetation is tropical, the street trees being mainly banyans (*Ficus retusa*), with a few specimens of *Eucalyptus*, flowering *Bauhinia*, *Casuarina*, etc.

The mainland adjoining Hongkong is made up of grassy, granite hills, with scattered groves of small pine trees. Even these have their lower branches trimmed off for fuel. Dried grass, reeds, small shrubs, are all gathered and used for

fuel. That this treelessness is man-made and not natural is evidenced by the dense thickets on Hongkong island. Along with this apparent disregard of trees and nature, one encounters an almost reverential regard for large trees near the villages. The general absence of trees and their local preservation are both caused by superstition. The waste lands are used by the thrifty Chinese as burying grounds, and it is a belief of theirs that trees around the graves are distasteful to the spirits of the dead. This belief, combined with the chronic fuel famine, has resulted in the Chinese keeping large areas of potentially valuable forest lands denuded of trees. On the other hand, since the Buddhist priests teach that trees are pleasing to the benevolent gods that preside over the temples and villages, large trees are encouraged in these places, and the villages are proud of their giant specimen trees and of the undisturbed forest adjoining their temples.

In contrast to this superstitious and wasteful attitude toward their uplands, the Chinese are justly famous for their intensive agriculture on the bottomlands. Beyond the hilly coastline that fringes the Canton delta one encounters a wide, level flood plain, with broad areas of overflow lands, on which are growing rice and vegetables in great variety.

The Chinese farmer usually relies on irrigation and frequent fertilizing to mature a bumper crop, and in these things he is skillful. He uses hand labor and carabaos just as is done in the Philippines, and he employs similar tools. His high yields seem to be solely a result of fertilizing. At least two applications of "night soil" are made for each crop.

The gardening methods of China are also familiar; for the Chinese in Manila follow the same methods, except where the law has prohibited unsanitary methods. Several vegetables are grown there which are not known here. Water chestnuts, cabbage, peas, beans, pechay, spinach, beets, and many cucurbits are common crops. At the time of my visit, in April, cucumbers, beets, string beans, and lettuce were in season.

Fertilizer practice is given careful attention, as the Chinese gardening is a system of continual watering and manuring of crops. Night soil is taken to the fields daily and allowed to ferment in large earthen jars until required. I could ascertain no regular procedure in ripening the material. It is always diluted before spraying it upon the crops. It is usually applied to vegetables three or four times a week. Animal manures are less efficiently handled and are apparently less valued. They are usually dried for shipment to a distance, and much of the nitrogen is thus lost. Of temperate small fruits I saw very little. Strawberries grow and fruit but apparently are not grown commercially. Raspberries, blackberries, currants, gooseberries, etc., do not seem to be cultivated at all, though there are some really superior wild raspberries. Some of these are decidedly worthy of trial in the Philippines.

Orcharding is an extensive industry both on the lowlands and on terraced hillsides. The island of Honam, opposite Canton city, has extensive orchards of apricots, carambolas, lychees, lungans, a few peaches, and several sorts of citrus. All of these are grown in wide beds, separated by trenches for drainage, often excavated to a depth of from one to two meters. There is standing water in the bottom of each trench. The trees are planted thickly along the tops of the high beds. So closely are they planted that the branches soon interlace, forming dense thickets. The citrus trees are spaced only about two meters apart. This

crowded planting is the outstanding characteristic of the lowland orchards. The trees are early fruiting and are soon attacked by insects and diseases; so they are short-lived and seldom reach a large size.

The citrus varieties are numerous and are propagated by layering and grafting. The little mandarin oranges are frequently imported into the Philippines. Besides these there are several sweet oranges related to our cajel, some very good sweet pummelos, and an especially large, juicy oranged-skinned lemon with salmon-colored flesh. Interplanted with the citrus are carambolas, apricots, wampei, and "Chinese olives," which are obtained from a species of *Canarium*, similar to our pili nuts. The whole fruits are picked green and pickled, and the seeds (nuts) are also cooked and eaten. They are bitter when raw. The orchards, like all of the other crops, are heavily fertilized.

One trip was made to Lau Kong monastery. This is in the hilly country bordering the delta on the north. There are narrow valleys in this region devoted to fruit growing by an entirely different system. Here the trees are grown on the hillsides, instead of in the bottoms. The slopes are built up into narrow terraces walled up with loose rock. These terraces are planted to a variety of orchard trees differing in size and habit. The whole effect, from a distance, is of a rocky hillside forest. Yet every tree on the hill is of a selected strain and is grafted from known stock. All of the terraces are well tilled and free from weeds. In these hill orchards there are no citrus (though they are grown principally on terraces in Japan). In fact, most of the species grown are temperate and subtropical: chestnuts, Kakis (so-called Japanese persimmons), pears, plums, apricots, Chinese olives, (*Canarium album* and *C. numila*), and lychees grafted on the mountain lychee. The best orchard belongs to the monastery, which was established during the Sung dynasty (420-479 A. D.) by the founder of the thirty-six villages in the valley and was first a school but was later converted into a monastery.

A few notes about the methods of tree propagation may be interesting. The method of grafting trees seems very primitive but appears to be effective. All of the grafts that I saw were either cleft grafts or side grafts on cut ends of branches. These were plastered with red mud and tied with straw. Thus no wax or binding tape was used. Yet by this method lychees are grafted successfully, and these are considered among the most difficult trees to handle, being propagated usually by air layering (marcottage). Another common and effective, though cumbersome, method of multiplication is by inarching. Young seedlings in straw baskets are hung on bamboo frames around a tree, and the small twigs of it are inarched on the seedlings, which are accordingly topped. I saw this practiced both on peaches and citrus.

The young trees, after transplanting, have their trunks wrapped with straw until they have developed enough crown to shade themselves. This protection is necessary, because the sunlight is more intense and the trees develop new crowns more slowly than in the Philippines. A rather odd practice is often followed in planting fruit trees. A mound of pond mud is built up around each tree at the time of planting, and, later, this is removed at intervals. Thus, a caked mass of mud is formed around the tree, and it looks to a stranger like a bad practice. Possibly the Chinese know what they are doing it for, and it may serve as fertilizer or as protection from stem borers.

Tea is an important product of South China, though it is not grown in the delta. A number of interesting plants are grown exclusively for tea flavoring, however. Indeed, there are so many of these that one may suspect that the Chinese are more fond of the perfumes in the tea than of the tea itself. One of the most abundant of these flavors is *Aglaiia odorata*, the flowers of which are fragrant and are much prized. Our common bush sampaguita, *Jasminum sambac*, is also grown as a field crop for the same purpose. A large acreage of roses is grown for the rose petals, which are dried and used for making candy. There are two commercial varieties; one, a light pink double flowered form, is most valued.

The absence or poor growth of certain plants in South China is quite as interesting as the presence of others. Thus, such pineapples and bananas as I saw were poor, frost-bitten things, evidently not at all at home. Very few sorts of bananas appeared in the markets, and these were expensive and of mediocre quality. Apparently, the banana season is in September and October, and they are scarce during the cool months. Mangoes also grow but do not fruit freely. Many very poor mangoes are imported from Indo-China, and there is a good demand for the few Philippine mangoes which reach Canton. Papayas also are grown only experimentally at the Canton Christian College; they fruit quite freely but are injured by the cold weather. Coconuts of course cannot be grown at all at Canton. Of temperate fruits, the bush fruits, apples and cherries, are conspicuous by their absence, though many fruits, commonly associated with them are abundant.

Poultry raising is among the important industries. Both dried and fresh eggs and poultry are exported. Indeed, a considerable part of the importation of eggs into the Philippines comes from this region. Whatever the quality of the Chinese eggs by the time they reach the Philippine consumer, I can testify that there are perfectly good eggs and chickens at Canton.

Chicken raising is largely a household industry just as it is in the Philippines. There are many more popular forms of gambling in China than cock fighting; so chicken raising is always a business, never a pastime. The common red and brown chickens are exceedingly variable, both in size and color, and indeed are not regarded as a distinct breed at all. They are for the most part excellent egg layers, the brown hens, called *mah*, being regarded as the better, though they are not a distinct strain. There are some fancy breeds kept, such as the black and the white frizzies, the black-fleshed white silkies, and the large "Cochins" from Swatow. Some of these might be useful as meat breeds in the Philippines. Certainly, a careful selection of superior stock of the common yellow Cantonese for importation into the Islands would be highly advisable, since they thrive well here.

The incubator business is a very ancient one in China and is conducted on a large scale. Some of the large hatcheries turn out thousands of chicks and ducklings a day. Most of the chickens and practically all of the ducks are hatched in incubators. The operators have a well-regulated system of heating their incubating houses and of handling the eggs, which are at first bulked and then transferred to smaller containers as incubation progresses. The whole industry is in the hands of specialists, many of whom become very expert.

The fattening of poultry for market is also an interesting procedure, showing marked differences in the characteristics of the Chinese and Philippine chickens.

The Chinese fatten their chickens in little narrow coops, preventing them from exercising at all. Such treatment would be decidedly harmful to our freedom-loving fowls, but the Cantonese chickens settle down in confinement and make fine, tender, fat chickens.

Just as *balot* is a characteristic product of the Tagalog provinces, the Chinese also have their preferences in the matter of eggs. One popular kind are pickled in brine for a few months, or until thoroughly impregnated with salt. Another kind is preserved in lime. Neither method makes an attractive looking product, but the flavor is indeed gamey.

One of the most highly organized industries is duck herding. Large flocks of these fowls are fed along the river dikes. Often they are housed in boats and are transported from place to place in search of the best pasturage. Often the entire capital of a family will consist of a boat and a flock of ducks, purchased anew each year from the incubators.

The hog is given the same seat of honor among the Chinese as among the Irish, his sleeping quarters being in the dwelling. The common breed of hogs are stockier than those of the Philippines, with excellent hams and shoulders, short noses, sway backs and protruding paunches, trailing on the ground. They are almost invariably black and white.

Two strains of cattle are raised, one of yellow cattle like those of the Philippines, which are for beef and for draft animals. These are very small and principally useful for beef; the other breed is dairy cattle which are all bred from imported stock and have to have special care at the dairies. They yield very good quantities of milk, being better producers than either the native cattle or carabaos. They are used in practically all of the large dairies. They are similar to the Holsteins in appearance, but are of shorter, broader build. The carabaos need no special comment, except that Indian dairy carabaos are used in the Hongkong dairy, and that rinderpest has not been observed around Canton at all recently.

All of the livestock are pastured on the grave lands which constitute a public common, with usually very poor forage. This applies to all except the dairy cows, which are stall-fed on green canal grass. Back in the interior above Canton, in Kwang-si province, there are extensive grasslands. Cattle raising is important and can be greatly extended as soon as there is a settled government.

There are, of course, practically no forests in China. The reason usually given is that the dense population have destroyed them all for fuel. Yet Japan, also with a dense population, has now and has always had extensive forests. One reason for this difference is in the attitude of the people. The Japanese have a real love of trees, untinged by fear. They bury their emperors under them as most fitting resting places. The Chinese have built up a body of superstitious beliefs and fears around their forests and big trees. So they apparently do not particularly love their forests. One of the contributory causes for the treelessness of China is undoubtedly the continental climate, with its dry hot summers, which make reforestation more difficult than in the moist insular atmosphere of Japan. When south China decides to adopt forestry, however, she will have no such climatic obstacles as were encountered in western United States. The native Chinese pine reseeds readily, and I am informed by Mr. Tutchter and Mr. Orm that the planting of one-year-old pine seedlings on the hills both of the islands

and of the mainland has been quite successful. The growth rate of these pines on the hills around Canton is rapid. They grow in height about 60 centimeters a year from the time they are one meter high until they attain about ten meters. The later diameter growth is also rapid, as is shown by the wide growth rings on felled trees. Altogether, all that is necessary to make forestry entirely practicable is to overcome the prejudice of the people.

The city of Canton, the metropolis of South China, is in itself a most interesting place. It was originally surrounded by a wall, which it first outgrew and now is tearing down as useless. There are many other changes taking place in the city under republican government, which are improving it as a large commercial city, but at the same time are destroying interesting relics of China's venerable past. But to really destroy the greatest charm of Canton for the visitor it will be necessary to change the lives and habits of the Chinese people. It is the everyday Chinese life, the narrow crooked streets, shops with odd native wares, the temples nestled back inside the city blocks, and the crowded ever-changing street scenes, that make up the attraction of Canton. The modern department stores and rickshaws on the Bund are a necessary incident to her maintenance of ascendancy as a commercial city, but her silk, matting, jade and ivory, and other trades are equally a part of it, and these change their ways more slowly.

The Cantonese in business is a progressive of pronounced type, but in his home life he is more conservative. He has traveled widely and in many cases made his money abroad, but he seldom took his family with him. So the home life remains essentially old-Chinese in manners and customs. If one is fortunate enough to be entertained by a well-to-do Chinese, one eats with chop-sticks, drinks tea out of a bowl, and sees a little of Old China as she has been for centuries. There is little attempt at indiscriminate copying of foreign ways.

Agricultural education has not developed as it has in the Philippines. The Canton Christian College gives the only college training in agriculture in South China. The staff of this College consists of twenty-four Americans and nine Chinese, some of whom also teach in the primary and middle schools. These schools are necessary as "feeders" to the College, since there is no general system of public education as in the Philippines. In agriculture, there are three teachers, Professor Groff, Mr. Levine, and Mr. Taam. The laboratories and students' and faculty houses are all large, substantial brick buildings, with tile roof. They are two and three story buildings, and thus give more room for the space occupied than do our one-story laboratories. All are built by an architect permanently employed by the College and are arranged according to a plan prepared by him. Thus the spacing and assignment of the buildings is good, and the whole effect is very pleasing.

The student body is drawn partly from the wealthier local Chinese of the province, but more largely from Chinese in foreign lands, who wish their sons to have an education and to know Chinese. So special instruction is given in the Chinese language in the College, and all instruction in the lower schools is in Chinese. Among the agricultural students were a few from Singapore, who speak English better than Chinese, and who are anxious to study coconuts, rubber, and other strictly tropical crops. They seemed much interested in the Philippine College of Agriculture.

The trade of the Canton region is now more with Indo-China, Formosa and other lands than with the Philippines. There are opportunities to develop trade along certain lines. The fruit trade might be profitably increased, as the demand for mangoes and bananas is good. Bananas, especially, are scarce and in demand from November to April, when our yield is heaviest. China competes with us in the purchase of Saigon rice and imports large quantities from there. In turn, we ought to be able to get glassware and porcelain in larger quantities from Canton. There is room for development of industries for export trade in both countries, and this would be of advantage to both.



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COMPARATIVE CULTURE OF UPLAND AND LOWLAND RICE, WITH SPECIAL REFERENCE TO COST OF PRODUCTION AND DISTRIBUTION OF INCOME¹

By RUFINO A. ISIDRO

The present paper is intended as a basis neither for extensive conclusion nor for wide judgment of the problem. The limitation of the work to four units excludes any possibility along this line. Rather, this paper is designed to indicate the general channels of investigations and more especially to serve as a model in calculations of the involved data when the survey shall be extended to a sufficient number of units to render conclusion and judgment arrived at sufficiently general. The writer desires to illustrate the difference in yield and cost of production and in distribution of income between some upland and lowland rice cultures.

The first part of this experiment consisted of results obtained by farmers from the barrios of Maahas and Anos, in the town of Los Baños. The data were secured personally by the writer through actual observation. The second part was carried out by the writer on the College Farm during the College year 1918-1919.

MATERIALS

MAAHAS LOWLAND CULTURE

The share arrangements between the landlord and the tenant are as follows:

The landlord furnishes the equipment, seed, land, and pays the land tax. The tenant pays all the expenses incurred for all the work, except harvesting. He lets the harvesting out on shares. Twenty per cent of the total yield is given to the harvesters. The balance, or 80 per cent of the harvested grain, is divided equally between the landlord and tenant. Thus the landlord and tenant each stand one-half of the harvest labor cost.

The farm from which the following data were obtained was worked under a single tenantry system. The land is an old field of six divisions, with a total area of 7,000 square meters. The field had been cropped for many years to rice. The land is provided with good irrigation from Maitim Creek. The field was first plowed on July 31, 1918, by the tenant with a native plow and a carabao. This work was finished in one six-hour day. To puddle the soil, the paddies were harrowed five times. The first harrowing took two days, beginning on August 1; the second harrowing was nine days after the first; the third ten days after the second; the fourth four days after the third; and the fifth six days after the fourth; finishing harrowing on September 6. This preparation was made while the land was under water; so as to kill the weeds and wild grass that start growth when left in the field; to clean the soil of all trash; and to mix and puddle the soil thoroughly and uniformly.

¹ Thesis presented for graduation from the College of Agriculture, No. 110. Experiment Station contribution, No. 31.

The variety of rice used was *Inintiw*. The seed was from the previous year's culture on the same land. This variety is preferred to many others because of its early maturing quality, resistance to drought, and high yielding power.

On August 20, the seedbed was prepared by using what is locally known as *dapog* method. This method is usually followed in Los Baños when the planting of the lowland rice is done late in the rainy season. The preparation was as follows: A portion of the paddy-field measuring fourteen square meters was well pulverized and irrigated by the tenant with one helper. The bed was covered with banana sheaths split into pieces of about six centimeters wide, and carefully laid side by side and sewed together with immature bamboo splits such as are used for tying purposes. Banana leaves were then laid over the banana sheaths. On the banana leaves fine, partially rotted compost was scattered evenly to a thickness of about three centimeters. The seeds were then broad-casted by hand evenly on the compost and covered with banana leaves to protect them from the birds. This seedbed preparation was finished in one day by the tenant and one helper.

On September 8, ten days after sowing the seedbed, the seedlings were transplanted. The seedlings were matted together by the intertwining of the roots and all in one sheath were taken in one piece to the field where they were to be planted. The seedlings were planted in hills about twenty centimeters apart both ways with an average of four seedlings to a hill. Transplanting was done in one day by twelve women and four men working on an average of eight hours. The distance between hills was not actually measured, only estimated by the planters as they worked.

Beginning two days after transplanting, water was allowed to run from paddy-field to paddy-field until the rice became mature. No other care was given excepting occasional weeding which consisted of pulling up weeds on the dikes, and between plants here and there. The plantation was visited by the tenant quite often during a period of 125 days. Beginning December 22, fifteen days before harvesting, a boy was employed to drive birds away from the rice field. The boy stayed on the watch from six in the morning till six in the afternoon.

Harvesting was begun January 5, 1919, and finished in a day by 25 women and 15 men. Some of the harvesters used a native sickle called *lilek* which is made of a slightly curved steel blade tapering to a point. The concave edge is the sharp cutting edge. It is about 20 centimeters long, one millimeter thick, and two and one-half centimeters wide. The handle is a piece of wood about 12 centimeters long and two and one-half centimeters in diameter. The women and the men who did not use the *lilek* used the *pang-ani*. The blade of this implement also is made of steel. It is shaped like a bow, the convex edge being the cutting edge. The blade is about 15 centimeters long, one millimeter thick, and two and one-half centimeters wide. The middle part of the straight edge is fastened crosswise in a groove in the middle part of a cylindrical piece of wood about 12 centimeters long one and one-half centimeters in diameter which serves as the handle. The difference in the use of these tools is that with the *lilek* a bunch of panicles is cut while with the *pang-ani* only one or sometimes two panicles are cut at a time.

Threshing and cleaning were also performed by the harvesters in the field. Threshing was done by tramping on the panicles and cleaning by winnowing in a flat basket called *bilao*, which is raised in both hands above the head, the grains

being poured slowly. In this process the empty grains and broken panicles are blown away and the good grains drop down from the basket.

The plants in the paddy-field in Maahas were very uniform throughout their development. As far as was observed neither diseases nor pests affected the rice severely. There was, however, some damage caused by the rice borer and some few panicles were mutilated by rats, but these damages did not amount to very much and did not markedly affect the yield. During the growth of the crop there was an ample supply of water furnished by irrigation, and it was apparently due to this that at the maturity of the crop the heads of rice were fairly well filled with grains.

ANOS UPLAND CULTURE

As in the lowland culture, data on the upland culture were personally obtained by the writer from the actual operations performed by a farmer on a field in the barrio of Anos, in the municipality of Los Baños. The land is an old rice field and has been cropped to rice for many years during the rainy seasons and to other crops during the rest of the year. The area planted measured 8,300 square meters.

Although the owner acted as tenant, for the purpose of this survey, the same system of tenantry was applied as in the case of the Maahas culture, the owner merely playing dual rôle of landlord and tenant. The reason for this is to place the resulting figures upon the prevalent tenure basis of the community.

The land was plowed three times, preparatory to planting. The farmer used a carabao for this operation and as the first plowing is intended to break the land it is usually shallow; the second is to stir up the soil to induce the rapid germination and growth of weed seeds found in the soil; and the third is to destroy the young weeds before they come to seed. After each plowing the ground was harrowed with a native bamboo harrow.

The seed used by the farmer was of the *Inintiw* variety from the last year's culture on the same land. As has been mentioned, this variety is preferred to others by most local farmers because of its early maturing quality, its resistance to drought, and its success in spite of weeds and poor cultural treatment. Preparatory to planting, the rows were marked by running furrows with the *lithao*, a native implement. This implement is made in the form of a standard native paddy harrow which is made of wood. The principal part is a bar, at the ends of which are adjusted vertical pieces of wood connected at the upper end by a cross piece which serves as a handle. On both of these vertical pieces, two naturally bent pieces of branches of trees are adjusted on the lower part, to which the straps for hitching are tied. The teeth are three in number, shaped like a lance, and are fastened to the main bar at intervals of about 20 centimeters. This implement is used for the double purpose of running furrows for planting and for cultivation before the rice is very tall. The implement is pulled by an animal and is handled by one man, who drives the animal and holds the implement down and keeps it running on as a straight line as possible.

The seeds were broadcasted instead of being drilled. The rate of seeding was one cavan (of 25 gantas) for an area of 8,300 square meters. If drilled, it would have required only about 22 gantas to the hectare, in rows 50 centimeters apart and planted 30 centimeters apart in the rows, as was practiced by the writer

in his culture on the College Farm. Immediately after broadcasting, the field was harrowed with a bamboo harrow across the furrows to cover the seed. By harrowing the field crosswise, most of the grains that were dropped on the space between the furrows were carried into the furrows. Thus ultimately the plants were run in rows.

Practically no cultivation was given to the field in the way of stirring the soil to establish soil mulch for conserving the moisture. The field was weeded twice by a number of men and women. The original stand was not thinned out, excepting as the plants were incidentally destroyed in weeding. The landlord believed that he could obtain a higher yield by using a larger rate of seeding.

The plantation was visited by the owner quite often during a period of 122 days. Twelve days before harvesting a boy was employed to scare birds away from the field. The boy stayed in the field from six in the morning till six in the evening every day till harvesting was over.

The methods used in harvesting were the same as those used in Maahas with the lowland culture. Within four to seven days after planting the Anos upland, a uniform stand of the crop was observed. The plants did not appear to be crowded, the rows being 20 centimeters apart, although there was no fixed distance between plants in the row. As with the lowland culture, few panicles were affected by diseases and pests, and only a few heads were destroyed by rats.

COLLEGE UPLAND AND LOWLAND CULTURES

Experiments similar in plan were carried on by the writer on the College Farm. The object was to see how other methods would compare in results with those in vogue on private farms. Data on these experiments were taken personally by the writer.

In the College cultures, the College was considered the landlord and the writer the tenant, for the purpose of this survey and the same system of tenantry was applied as in the case of the Maahas culture.

In carrying out this work, the following operations were involved: (a) The selection of site for the field; (b) the preparation of the ground for both upland and lowland cultures; (c) the securing of seed for planting; (d) personal performance of field work and directing and supervising the laborers employed as helpers; (e) the taking of field notes; (f) irrigation of the lowland culture during inspection.

All the available fields on the College Farm at the time this work was taken up, were occupied by cultures of the Agronomy Department; so no choice of land for this experiment was possible. A piece of land measuring exactly one hectare, adjoining the paddy-fields located near the main road leading to the Administration Building, was assigned for the work. The land was generally level, but sloped gradually from south to north. The soil was rather coarse, the surface, apparently, was composed of coarse sand, with a mixture of clay loam and small particles of adobe stones; in the deeper layers in what may be termed the sub-soil, the soil was still coarser, and of a yellowish color that indicated the presence of considerable decomposed adobe rock mixed with pebbles and gravel. The land seemed to be well drained. The field was divided into two equal parts from east to west, the southern half of which was used for upland and the northern half for lowland rice. As the field had been under continuous cultivation for the last seven or eight years

it was quite free from noxious weeds. The last half had been previously planted to yautia, dasheen and gabi, and the west half to several kinds of farm legumes.

Upland culture

Seed of upland rice varieties, Quinastila and Inintiw, bearing the College Numbers 4495 F₃ and 3050 F₃, respectively, was obtained from the Agronomy Department. The seed was produced from the multiplication plots of 1917-1918 cultures of Ramon Habaluyas.²

The first plowing was done on May 14, 1918, with a three-bullock plow handled by two men, one driving the team and the other holding the plow. It was found necessary to use this kind of plow to plow the soil deeply enough. The land was harrowed by one man on May 16, with a bamboo harrow, pulled by a bullock. The bamboo harrow was used instead of the disc harrow because the soil was quite soft and friable. On June 6, the land was plowed again with a single-animal plow, to pulverize the soil and to stir up the weed seeds in the soil so they would grow, in order that the weeds could be more effectively eradicated by the subsequent plowing. On June 22, the land was again plowed with a single-animal plow, primarily to kill the weeds that had sprung up. It took 81 hours to perform all the operations.

Two days after the last plowing, the land was divided into four lots and pegged. Furrowing followed, making the rows 50 centimeters apart. The object of dividing the land into four instead of two lots, since the number of rice varieties to be sown was only two, was to sow the seeds of one variety in two different places of the field. The two varieties were then sown side by side in each half of the field. In this way both varieties were represented in two separate lots on the field, thus equalizing the chances for the development of the two varieties.

In furrowing, practically the same method, with some minor exceptions, as the one used in the barrio of Anos was followed. One difference was, that the furrowing implement used in this case was wider, having two teeth more than that used by the Anos farmer. Two men were needed to run the five-tooth furrer. The distance between teeth was 25 centimeters.

Planting was done on June 25, immediately after harrowing. Points 30 centimeters apart were marked with paint on a line used to indicate the hills in the row. The line was placed along every other furrow, leaving a space of 50 centimeters between the rows. The seeds were then dropped by hand at the points marked on the line. Six to ten seeds were planted to a hill to make the stand surer and at the sametime to give a wider range for selecting the best seedlings at the time of thinning. The seeds were covered by pushing in the soil and compacting it with the feet. The use of a marked line was resorted to, because the College has no rice drilling machine.

The distance of planting, 50 centimeters between rows and 30 centimeters between hills, and the use of hand weeding supplementary to animal cultivation was recommended by Alfonso de la Paz.³

² *Multiplication of some selected strains of upland rices*, thesis carried out during the College years 1917-1918 and 1918-1919; not yet published.

³ *Cropping of rice by bullock labor*, thesis carried out during the College year 1917-1918; not yet published.

On July 29, thinning, replanting of vacant hills and partial weeding were all done by hand at the same time. Only from two to three seedlings were left to a hill, so that the plants would not be crowded.

The first cultivation with animal was on July 19, using a five-tooth cultivator. Cultivation was finished in one and one-half days. Great care was exercised so as not to injure the plants. The last cultivation was on August 15.

For twenty days before harvesting a laborer was employed to keep the birds away from the field.

Harvesting was begun on October 23. The method used was the one in vogue on the neighboring farms. The stalks were cut about five to ten centimeters above the ground with the lilek, supplemented with a bolo. To facilitate rapid loading on the cart, as fast as the rice was cut it was tied in big bundles with thin splits of young bamboo such as is usually used for tying. Hauling was started October 24, using a cart pulled by a bullock, one man being employed. The work was finished in four days.

In threshing, two methods were employed. Part of the rice was threshed by tramping and part by a small threshing machine run sometimes by hand and sometimes by a motor. The grain was winnowed twice, by the use of *hunkoy*, a native winnowing machine turned by hand. Two men were employed to run the winnowing machine. After the rice was thoroughly cleaned it was dried, weighed, and stored in large boxes.

The crop as a whole developed rather uniformly from germination to maturity. A few heads were found to be attacked by the rice borer. The amount of damage done was computed as a part of the total loss.

Lowland culture

The west half of the field was used for lowland rice culture. The first operation was the building of dikes. The field was divided into six oblong paddy-fields separated from each other by dikes which were 400 meters long, 75 centimeters wide, and 75 centimeters high. In building the dikes the writer performed part of the work, and day laborers did the rest. The process consisted of spading up and mounding the soil along the line where the dike was to extend. The soil was tramped over from time to time to make the dikes strong and compact. Spades were the only tools used for this operation.

It is a common practice with our farmers in building paddy-fields, even though the land is rather level, to divide it into many small plots. The object of doing this is not known. The practice reduces the planting area, as much space is occupied by the many dikes. The writer has found in his experience that considerable expense is incurred in making dikes, especially on land having much grade. The first expenditure is increased by the waste of energy and the time required in the preparation of the plots, because small plots require, in plowing and in subsequent operations, a considerable number of turnings by the men and the animal used in the work. To avoid this unnecessary expense and waste, the writer made an effort in this experiment to build as large paddy fields as the lay of the land permitted.

Grading was started July 22. Irrigation water was first turned into the plots to soften the soil; then the higher places as indicated by the level of the water were plowed with a single-animal plow. The leveling followed, using the ordinary

lowland-rice vertical iron harrow adjusted so that it would serve as a scraper. This operation was repeated as many times as it was necessary to establish a level bed, as gauged by the water flowing into the plots while the work of grading was going on.

After the land was graded the soil in the paddies was allowed to harden by cutting off the water supply from the irrigation canal. On September 5, the first plowing was done using a single-animal plow. The land was harrowed with a native lowland-rice vertical iron harrow, and then the entire field was divided into four lots and the same method of separating the varieties as was used in the upland culture was followed.

The varieties used were *Binanbang* and *Macan-masinsin*, bearing the College Numbers 10231 and 10232, respectively. *Macan-masinsin* was obtained from Cabuyao, Laguna, and *Binanbang* from Calamba, Laguna, on April 20, 1918.

An old rice field of about 150 square meters was assigned to the writer on July 15, for use as a seedbed. It had been previously planted to corn. The first operation consisted of cutting the grass and weeds in the field. Water was run into it on July 18, to soften the soil for plowing. The first plowing was done on the same day, using a single-animal plow. This was finished within one hour. After this the bed was kept under water until planting time. On July 19, the land was harrowed for the first time, using a standard lowland rice harrow made of iron. It took one and one-half hours to do the harrowing. The second plowing took place seven days after the first. The second harrowing, which required two hours, was done ten days after the first. Leveling was done by a bullock dragging a banana stem about a meter long over the surface of the bed. The surplus water was drained from the bed by means of a small canal made on one side of it. Another canal was built through the middle of the bed for draining the land and keeping the two varieties separate.

To insure a sufficient number of seedlings for transplanting, the usual amount of seed sown in the bed was doubled; that is, 11 gantas, or 33 liters, for each variety were used. The seeds were soaked in water for twenty-four hours on July 25. After soaking, they were put in two separate boxes and covered with rags. They were kept moist for three days by occasional sprinkling with water. At the end of the third day, most of the seeds were found to have sprouted. The sprouted grains were planted July 29, by broadcasting them evenly on the surface of the bed. Irrigation was withheld from the bed until the seedlings had secured a firm hold in the ground; then the water was turned in from time to time. Forty-three days from the date of planting the seedlings were about 30 centimeters tall, the proper size for transplanting.

Germination was very uniform. Throughout the development of the growth of the seedlings, no diseases nor pests were found. When the seedlings were about five weeks old, it was found that their stand was too thick, and as a result the seedlings were slender.

Following the usual method, the seedbed was first irrigated before the seedlings were pulled from the bed—so that the roots would be injured as little as possible. The transplanting was done September 1. The seedlings were pulled up by hand. The roots were cleaned of the soil adhering on them by striking the base of the plants against the operators' toes. They were tied in small bundles about three and one-half centimeters in diameter with thin bamboo splits such as are

usually used for tying. The seedlings were topped by pushing the bundles one by one against the edge of the blade of a bolo set in a piece of wood. After cutting the tops, the seedlings were reduced to about 18 centimeters in length. The object of the topping was to lessen transpiration. After cutting, the bundles of seedlings were carried to the fields and scattered around the paddies, so as to be within easy reach of the planters.

The bundles were untied, and transplanting was done by pushing from two to three seedlings to a hill into the puddled bed of the paddy. The hills were set from twenty to twenty-five centimeters apart. The planters held the bundles in the left hand while setting the seedlings with the right hand in the muddy ground. The planting distance was not measured exactly, but only roughly estimated by the planters as they planted the seedlings.

Irrigation was begun four days after planting. This was continued by allowing the water to flow in from time to time till January 24, 1919. At this time the flow of water was cut off, the rice being already well advanced in maturity. Hand-weeding was done October 9, and also in November 25. From January 6 until time of harvesting a laborer was employed to keep the birds away from the field.

Harvesting was done on January 15. The method was the same as that employed with the upland culture on the College Farm. After harvesting, the rice was hauled to the seed-house.

A few days after hauling, threshing was begun. The methods used in threshing were the same as those used in the College upland culture.

A week after transplanting, most of the seedlings had sent out new leaves. As the seedlings became older, the plants, which happened to be in places where the surface soil had been badly scraped off in the process of leveling, were decidedly stunted, while the opposite condition existed on the level parts which had been filled up with soil from the elevated places. This result is common on newly graded rice fields. During the months of November and December, when the plants were in the full period of development, the paddies were affected seriously by drought, and the necessary water could not be supplied by the irrigation plant of the College. This resulted in low yields of this particular crop.

DETERMINATION OF COST OF PRODUCTION

FACTOR TABLES

The cost of production was calculated from six *factor* tables. The following notes are given in explanation of these tables.

TABLE I.—*Land costs.*

Culture.	I. Fertilizer cost.	II. Yearly tax.	III. Total yearly land cost.	IV. No. of cultures per annum.	V. Total land cost per culture.
a. Maahas.		P.8300	P.8300	2	P.1150
b. Anos.		.6640	.6640	2	.3320
c. College upland.		.8300	.8300	2	.4150
d. College lowland.		.8300	.8300	2	
e. Separate seed bed.		.2490	.2490	8 ^a	.4471

^a Seedbed occupied for one and one-half months.

Land cost, Table I

Table I, showing land costs, was tabulated as follows:

Column I. Fertilizer cost.—Although no fertilizer was used in the plots here considered, this item is included in the table for the sake of completeness.

Column II. Yearly tax.—The legal existing land tax rate of .0083 per cent was charged against land valuation. In the case of Maahas and Anos plots the owner's valuation was accepted. In the College plots and seedbed the valuation was given by Professor Elayda.

Column III. Total yearly land cost.—The total annual land cost was found by adding columns I and II.

Column IV, Number of cultures per annum.—Under this head was recorded the number of rice or other cultures grown during one year. In the case of the Maahas plot two rice cultures were grown on the same land in one year. The Anos plot produced one culture of rice and one culture of corn during the year. The College plots served for two cultures during the year; the seedbed, serving for one and a half months for this experiment, was charged at the rate of one eighth of its possible yearly service.

Column V, Total land cost of culture.—The total land cost for the culture was determined by dividing column III by column IV. For the purpose of computing total land cost in the summary table, the table I totals for sections *d* and *e* are taken together.

TABLE II.—Seed and seedbed costs.

Culture.	I. Seed.	II. Seed cost.	III. Land cost.	IV. Animal cost.	V. Imple- ment cost.	VI. Labor cost.	VII. Total seedbed cost.
	<i>Liters</i>						
<i>a.</i> Maahas.	90	₱6.0000	(<i>a</i>)	(<i>b</i>)	(<i>c</i>)	(<i>d</i>)	
<i>b.</i> Anos.	75	5.0000	(<i>e</i>)	(<i>e</i>)	(<i>e</i>)	(<i>e</i>)	
<i>c.</i> College upland. . .	34.5	2.3000					
<i>e.</i> College lowland. .	67.5	4.4000	₱.0321	₱.0462	₱.0083	₱4.5461	4.6327

(*a*) This cost is included in Table I, column V, section *a*.

(*b*) This cost is included in Table III, column IX, section *a*.

(*c*) This cost is included in Table III, column X, section *a*.

(*d*) This item of labor was performed by the tenant and the number of hours spent is included in Table VII, column *a*, line 37, upon the basis of which the tenant's labor income is computed.

(*e*) No entries made in these columns for sections *b* and *c* because the Anos and College upland cultures were planted direct and of course no seedbed was used.

Seed and seedbed cost, Table II

Table II was formulated for the purpose of calculating seed and seedbed cost.

Column I, Seed.—Under this head the quantity of seed used is recorded.

Column II, Seed cost.—The entry in this column represents the actual market value of the seed used in the culture.

Column III, Land cost.—The land cost for the seedbed was calculated in Table I, section *e*. In the case of Maahas plot the land used for seedbed was a part of the plot and was itself planted. In the case of the Anos and College upland plots a seedbed was not, of course, used.

Column IV, Animal cost.—The value of animal labor used in the preparation of the seedbed, as calculated in Table III, section *e*. In the case of the Maahas plot this cost is included in the animal cost for the entire culture.

Column V, Implement cost.—Under this head is given the value of depreciation of implement attributed to cultivation of the seedbed, as calculated in Table III, section *e*. In the case of the Maahas culture this cost was included in the implement cost for the entire culture.

Column VI, Labor cost.—The total of all wages paid to laborers on the seedbed, as calculated in Table VI, section *e*. In the case of Maahas culture, this item of labor was performed by the tenant, and the number of hours spent is included in Table VII, column *a*, line 37, upon the basis of which the tenants labor income is computed.

Column VII, Total seedbed cost.—The sum of all seedbed cost from columns II, III, IV, V, and VI is here entered as the total.

Animal and implement cost, Table III

Table III contains the details and totals as regards the employment of animals and of implements upon the various cultures and was calculated in the following manner: (In general it may be said that sections *a* and *b* of this table are empirical, and sections *c*, *d*, and *e* are based upon estimates furnished by Professor Gonzalez of the Animal Husbandry Department and Professor Cuzner of the Engineering Department of the College of Agriculture.)

Column I, Value.—In this column the cost price of the animal or implement at the time of purchase is recorded.

Column II, Years to stand.—Under this head is given the number of years that the animal or implement can normally be expected to render full service.

Column III, Yearly depreciation.—The yearly depreciation is the amount charged every year for the purpose of forming a sinking fund for the replacing of wornout animals and equipment. The amount was calculated by dividing column I by column II. In the case of carabao, sections *a* and *b*, Professor Gonzalez estimated that at the end of the animal's farm employment it could be sold for meat for 40 per cent of its original cost. This modified the calculations, so that 60 per cent of column I was divided by column II. In the case of the bullocks under sections *c*, *d*, and *e*, by advice of the same authority and for the same reason 40 per cent of column I was divided by column II.

Column IV, Yearly cost.—As yearly depreciation is the only cost entered in this table, the interest charge having been left for calculation in the Summary Table, yearly cost is equivalent to yearly depreciation. Therefore, column III was repeated in column IV.

Column V, Hours used a year.—The length of time the animal or implement was used during the year. As regard the Maahas and Anos cultures, sections *a* and *b*, this was determined by doubling column VII. As regards the College plots sections *c*, *d*, and *e*, it was found to be impossible, in the absence of any record pertaining to this point, to arrive at an accurate result. The writer has observed that College animals and implements are generally employed for six hours each day that they are on duty. Professors McLean and Hester estimated the maximum working days a year of College animals at 150, and of College implements at 120.

Column VI, Cost per hour.—This item was calculated by dividing column IV by column V.

TABLE III.—*Animal and implement cost.*

	I. Value	II. Years to stand.	III. Yearly depre- ciation.	IV. Yearly cost.	V. Hours used a year.	VI. Cost per hour.	VII. Hours per culture.	VIII. Cost per culture.	IX. Total animal cost.	X. Total imple- ment cost.
<i>a. Maahas</i>										
Carabao.....	P180.0000	10	10.8000 ^a	P10.8000	225.5700	P.0478	112.7850	P5.3911	P5.3911	
Native plow.....	12.0000	5	2.4000	2.4000	85.0000	.0282	42.5000	1.1985		P1.6975
"Suyod" iron harrow.....	10.0000	10	1.0000	1.0000	140.5700	.0071	70.2850	.4990		
<i>b. Anos</i>										
Carabao.....	150.0000	10	9.0000 ^a	9.0000	338.8300	.0266	169.4150	4.5064	4.5064	
Native plow.....	12.0000	5	2.4000	2.4000	196.8300	.0121	98.4150	1.1908		1.6906
"Lithaw" furrower.....	4.0000	4	1.0000	1.0000	12.0000	.0833	6.0000	.4998		
<i>c. College upland</i>										
Bullock.....	132.0000	7	7.5429 ^b	7.5429	900.0000	.0084	224.8200	1.8875	1.8875	
"3-vaca team plow".....	24.8500	9	2.7611	2.7611	720.0000	.0038	18.0000	.0684		
"Luzon Lagio" plow.....	10.1800	9	1.1311	1.1311	720.0000	.0016	40.0200	.0640		
"Lithaw" furrower.....	5.0000	4	1.2500	1.2500	720.0000	.0017	3.6000	.0061		
5-tooth cultivator (2 wheeled)	30.0000	10	3.0000	3.0000	720.0000	.0042	19.0002	.0798		
Cart.....	90.0000	8	11.2500	11.2500	720.0000	.0156	49.0200	.7647		
Threshing machine.....	100.0000	20	5.0000	5.0000	720.0000	.0069	27.4800	.0496		
Motor.....	212.0000	15	14.1333	14.1333	720.0000	.0196	3.0000	.0588		1.1166
"Hunkoy" native winnow.....	40.0000	20	2.0000	2.0000	720.0000	.0028	9.0000	.0252		
<i>d. College lowland</i>										
Bullock.....	132.0000	7	7.5429 ^b	7.5429	900.0000	.0084	58.5000	.4914		
"Luzon Lagio" plow.....	10.1800	9	1.1311	1.1311	720.0000	.0016	21.9600	.0351		
"Suyod" iron harrow.....	10.0000	10	1.0000	1.0000	720.0000	.0014	32.4900	.0455		
Wheelbarrow.....	13.0000	3	4.3333	4.3333	720.0000	.0060	15.4500	.0927		
Cart.....	90.0000	8	11.2500	11.2500	720.0000	.0156	10.0500	.1568		
Threshing machine.....	100.0000	20	5.0000	5.0000	720.0000	.0069	9.0000	.0621		4878
Motor.....	212.0000	15	14.1333	14.1333	720.0000	.0196	3.9000	.0784	5376	
"Hunkoy" native winnow.....	40.0000	20	2.0000	2.0000	720.0000	.0028	3.9000	.0109		
<i>e. College seed bed</i>										
Bullock.....	132.0000	7	7.5429 ^b	7.5429	900.0000	.0084	5.4960	.0462		
"Luzon Lagio" plow.....	10.1800	9	1.1311	1.1311	720.0000	.0016	3.0000	.0048		
"Suyod" iron harrow.....	10.0000	10	1.0000	1.0000	720.0000	.0014	2.4960	.0035		
<i>f. College culture; building dikes and grading</i>										
Bullock.....	132.0000	7	7.5429 ^b	7.5429	900.0000	.0084	249.0000	2.0916	2.0916 ^c	
Spade.....	3.0000	4	.7500	.7500	720.0000	.0010	305.4000	.3054		
"Luzon Lagio" plow.....	10.1800	9	1.1311	1.1311	720.0000	.0016	79.0002	.1264		
"Suyod" iron harrow.....	10.0000	10	1.0000	1.0000	720.0000	.0028	170.0004	.4760		9078 ^c

^a Yearly depreciation figured on basis that carabao can be sold for meat for 40 per cent of original value at the end of ten years.

^b Yearly depreciation figured on basis that bullock can be sold for meat at 60 per cent of original value at the end of seven years.

^c These amounts are included under "Land and improvements," column IV, section 4, Table V.

Column VII, Hours per culture.—The actual time the animal or implement was used in the culture, determined by the observation of the writer.

Column VIII, Cost per culture.—The cost for the use of a particular animal or implement charged to a culture. It was calculated by multiplying column VI by column VII.

Column IX, Total animal cost.—In this column is given the total cost of all animals employed in one culture; that is, the sum of all animal cost items in the column VIII, under each section. For the purpose of computing total animal cost entry for the College lowland culture in the Summary Table the items under sections *d* and *e* are taken together.

Column X, Total implement cost.—In this column is given the total cost of all implements employed in one culture; that is, the sum of all implement cost items in column VIII under each section. For the purpose of computing the total implement cost entry for the College lowland culture in the Summary Table the items under sections *d* and *e* are totaled together.

Supply costs, Table IV

TABLE IV.—*Supply costs.* ^a

Culture.	I. Item.	II. Value.	III. Total supply cost.
b. Anos upland.....	Bamboo harrow.....	P1.5000	P1.5000
c College upland.....	Bamboo harrow.....	1.5000	
e College upland.....	String.....	.2600	1.7600

^a The items involved in this table stood use for one culture only.

Table IV shows the value of supplies consumed by each culture.

Column I, Item.—Here is listed each item of supply.

Column II, Value.—In this column is given the cost at time of purchase for each item.

Column III, Total supply costs.—This is a total of all amounts in column II applying to each culture.

Investment, Table V-A

TABLE V—A—*Investment charged to Maahas and Anos cultures.*

Items.	Maahas. ^a	Anos. ^b
	Value of items.	Value of items.
Land and Improvements.....	P100.0000	P 80.0000
Animal.....	180.0000	150.0000
Native Plow.....	12.0000	12.0000
Supplies.....		1.5000
Iron Harrow ("Suyod").....	10.0000	
Furrower ("Lithaw").....		4.0000
Total Rice Production Investment.....	P302.0000	P247.5000

^a Area, .70 hectare.

^b Area, .83 hectare.

Table V—A shows the items and totals of investment for Maahas and Anos cultures.

*Investment, Table V-B*TABLE V—B—*Investment charged to College cultures separate seedbed.*

Items.	I. College invest- ment.	II Days used by College.	III. Days used on culture.	IV. Investment charged to culture.	V. Total investment per culture.
c. College upland ^a					
Bullock.....	₱132.0000	150	37.4700	₱ 32.9736	
3-Bullock Team-Plow.....	24.8500	120	3.0000	.6213	
Luzon-Lagio.....	10.1800	120	6.7000	.5684	
"Lithaw".....	5.0000	120	.6000	.2500	
5-tooth Cultivator (2-wheel- ed).....	30.0000	120	3.1667	.7833	
Cart.....	90.0000	120	8.1700	6.1275	
Threshing Machine.....	100.0000	120	4.5800	3.8167	
Motor.....	212.0000	120	.5000	.8833	
"Hungkoy".....					
(Native Winnow).....	40.0000	120	3.5000	1.1667	
Supplies.....				1.7600	
Land and Improvements...				100.0000	₱148.9508
d. College Lowland ^b					
Bullock.....	132.0000	150	9.7500	8.5800	
Luzon-Lagio.....	10.1800	120	3.6600	.3100	
"Suyod".....	10.0000	120	5.4150	.4513	
Wheel Barrow.....	13.0000	120	2.5750	.2789	
Cart.....	90.0000	120	1.6750	1.2563	
Threshing Machine.....	100.0000	120	3.5000	2.9167	
Motor.....	212.0000	120	.6500	1.1483	
"Hungkoy".....	40.0000	120	2.0830	.6943	
Land and Improvements...				164.4494	
e. College Seedbed ^c					
Bullock.....	132.0000	150	.9160	.8061	
Luzon-Lagio.....	10.1800	120	.5000	.0424	
"Suyod" Iron Harrow.....	10.0000	120	.4160	.0347	
Land and Improvement.....				5.0771	

^a Area .5 hectare.^b Area .5 hectare.^c Area .015 hectare.^d This amount includes amounts under column IX, X, Table III, section and column VI, Table VI, section 4.

Table V—B, dealing with the College cultures, shows the items and totals on investment, for the College plots and method of their calculations.

Column I, College investment.—In this column is given the cost of animals and implements at time of purchase. The figures for implements were obtained from the Disbursing Officer of the College of Agriculture. The figure for the bullock was given by Professor Gonzalez as the average purchase cost of all College bullocks.

Column II, Days used by College.—In this column is given the number of days each year, that the item was used by the College; determined as in Table III.

Column III, Days used on culture.—In this column is entered a computation of the number of days at the rate of six hours a day that the animal or implement was actually used in the culture. This was found by dividing column VII in Table III by six.

Column IV, Investment charged to culture.—In this column is recorded the proportion of investment of each item charged due to the experiment. These amounts were calculated by dividing column I by column II and multiplying the quotient by column III.

Column V, Total investment per culture.—This was determined by adding all the items of column IV for each culture. For purposes of computing landlord's interest with summary table interest on investment, the total for the College seed-bed is added to the total for the College lowland culture.

TABLE VI.—*Outside labor costs.*

Culture.	I. Item.	II. Kind.	III. Wage per hour.	IV. No. of hours for item.	V. Labor cost.	VI. Total labor cost per culture.
a. Maahas	Bird guarding . .	Boy	P.0500	180.6600	P9.0330	
	Transplanting . .	Men and women .	.1000	112.5000	11.2500	
	Reaping and threshing combined ^c	Men and women .	.0855	289.5000	24.7523 ^a	P45.0353
b. Anos	Weeding	Men and women .	.0700	200.0000	14.0000	
	Bird guarding . .	Boy	.0500	130.0000	6.5000	
	Reaping and threshing ^c	Men and women .	.0866	270.0000	23.3820 ^b	43.8820
	Plowing	Men	.0880	58.1667	5.1187	
	Harrowing	Men	.0880	19.2500	1.6940	
	Furrowing	Men	.1000	7.5000	.7500	
	Surveying	Men	.1000	4.0000	.4000	
	Planting	Men	.1000	20.0000	2.0000	
c. College culture, upland field	Thinning, re- planting and weeding	Women	.0667	238.2500	15.8913	
	Cultivation	Men	.1110	19.5000	2.1645	
	Driving birds . .	Boy	.0700	157.0000	10.9900	
	Reaping ^c	Men	.0940	64.0000	6.0160	
	Hauling ^c	Men	.1050	49.0000	5.1450	
	Threshing ^c	Men	.1070	116.0000	12.4120	
	Removing stalks and leaves ^c	Men	.1000	4.6667	.4667	
	Winnowing ^c	Men	.1000	21.0000	2.1000	65.1482
	Plowing	Men	.1110	22.0000	2.4420	
	Harrowing	Men	.1110	33.0000	3.6630	
	Preparation of bamboo slats . .	Men	.1000	3.0000	.3000	
	Pulling and top- ping	Men	.1000	10.6667	1.6667	
	Hauling	Men	.1000	6.2500	.6250	
	Transplanting . .	Women	.0750	63.0000	4.7250	
d. College culture, lowland field	Weeding	Women	.0667	249.0000	16.6083	
	Driving birds . .	Boy	.0700	117.0000	8.1900	
	Reaping ^c	Men	.0900	108.5000	9.7650	
	Hauling ^c	Men	.1000	26.0000	2.6000	81.4944
	Threshing ^c	Men	.1000	116.3330	11.6333	
	Removing of lea- ves and stalks ^c . .	Men	.0900	28.5000	2.5650	
	Winnowing ^c	Men	.1110	11.5000	12.7650	
	Weeding	Women	.1110	4.0000	.4440	
	Plowing	Men	.1000	3.0000	.3000	
	Harrowing	Men	.1110	2.5000	2.7750	
	Irrigating	Men	.1110	.5000	.5550	
e. College seed bed	Leveling	Men	.1110	1.2500	.1388	
	Building canal . .	Men	.1000	1.3330	.1333	
	Planting	Men	.1000	2.0000	.2000	
f. Building di- kes and grad- ing	Spading	Men	.1000	305.5000	30.5500	
	Plowing	Men	.1000	138.5000	13.8500	
	Harrowing	Men	.1000	170.5000	17.0500	61.4500 ^d

^aPaid in kind, cash wages computed on market value of commodity at times of harvest.

^bPaid in kind, cash, wages computed on market value of commodity at time of harvest.

^cItems of harvest labor.

^dThis amount is included under "Land and Improvements" Column IV section *d* Table V.

Outside labor costs, Table VI

Table VI was formulated to show the total labor cost chargeable to each culture. The term "outside" is employed to designate that the labor of the tenant was not here included, as it was left for computation on the basis of tenant's labor income in the Summary Table. This method is parallel to that of leaving the landlord's interest charges for computation on the basis of landlord's interest on investment in the Summary Table.

Column I, Item.—In this column are given the different phases of work performed in each culture.

Column II, Kind.—This column shows the class of laborers employed on the different items of work.

Column III, Wage per hour.—This is a computation arrived at under sections *a* and *b* by dividing column V by column IV. Under sections *c*, *d*, and *e*, the figure was obtained by dividing the wage per day by the required number of working hours, as College laborers worked by the day rather than by the job. Wherever group labor was employed and different wages were paid to the different members of the group, the entries under this column are averages.

Column IV, Number of hours for item.—This is a record from observation of the number of laborer-hours spent on each item.

Column V, Labor cost—The actual amount paid for each item of work.

Column VI, Total labor cost per culture.—This represents the total cost for labor expended on each culture. This total was determined by adding all the figures under column V for each culture. For purposes of computing the total outside labor entry in the Summary Table, the items under sections *d* and *e* are taken together.

SUMMARY OF YIELD, COSTS, INCOME, AND DISTRIBUTION, TABLE VII

Yield

Line 1, Theoretical yield.—The computed yield if there were no loss; determined by subtracting line 4 below from one hundred and using the remainder as divisor of line 2 below. By multiplying the quotient by one hundred, a product is obtained which is considered the theoretical yield.

Line 2, Actual yield in cavanos.—Under this head are given the actual yields in cavanos of the various cultures.

Line 3, Difference between theoretical and actual yield.—This line gives results obtained by subtracting line 2 from line 1.

Line 4, Percentage of loss.—By picking at random 200 panicles just before threshing and counting the number of grains missing from each panicle, the average percentage of loss here given was estimated.

Line 5, Actual yield in cavanos per hectare.—The division of line 2 (the yield of each culture) by the indicated hectarage of the particular plot gives the yield in cavanos per hectare.

Line 6, Market price per cavan.—Under this head is given the price of "palay" in the open market at time of harvest.

Line 7, Gross income.—This was found by multiplying line 2 by line 6.

Line 8, Gross income per hectare.—This was determined by multiplying line 5 by line 6.

Landlord's costs

In considering the landlord's cost, reference should be made to page 213, where the agreed method of distribution is described.

Line 9, Land cost.—Under this head is given the determination of column V Table I.

TABLE VII.—*Summary of yield, costs, income and distribution.*

Item.	a. Maahas lowland culture. (.70 ha.)	b. Anos upland culture. (.83 ha.)	c. College upland culture. (.50 ha.)	d. College low- land culture and seed bed. (.015 ha.)
I. <i>Yield</i>				
1. Theoretical yield, cavares.....	P23.6842	P22.3680	P17.2856	P8.8049
2. Actual yield, cavares.....	22.5000	21.2500	15.2800	7.2200
3. Difference between theoretical and actual yield, cavares.....	1.1842	1.1180	2.0056	1.5849
4. Percentage of loss.....	.0500	.0500	.1160	.1800
5. Actual yield, cavares per ha.....	32.1428	25.6024	30.5600	14.4400
6. Market price per cavan.....	5.5000	5.5000	5.5000	5.5000
7. Gross income.....	123.7500	116.8750	84.0400	39.7100
8. Gross income per hectare.....	176.7854	140.8132	168.0800	79.4200
II. <i>Landlord's costs</i>				
9. Land.....	.4150	.3320	.4150	.4471
10. Seed.....	6.0000	5.0000	2.3000	4.4000
11. Animal.....	5.3911	4.5064	1.8875	.5376
12. Implement.....	1.6975	1.6906	1.1166	.4878
13. Supplies.....		1.5000	1.7600	
14. Labor ($\frac{1}{2}$ harvesting).....	12.3762	11.6910	13.0699	19.6642
15. Total.....	25.8798	24.7200	20.5490	25.5367
16. Cost per cavan.....	1.1502	1.1162	1.3448	3.5369
17. Cost per hectare.....	36.9706	28.5774	41.0980	51.0734
III. <i>Tenant's costs</i>				
18. Outside labor.....	32.6591	32.1910	52.0783	61.8303
19. Cost per cavan.....	1.4492	1.5149	3.4082	8.5631
20. Cost per hectare.....	46.5813	38.8151	104.1566	132.6606
IV. <i>Total costs</i>				
21. Landlord's and tenant's.....	58.5389	56.9110	72.6273	77.3670
22. Total cost per cavan.....	2.5994	2.6311	4.7531	12.7417
23. Total cost per hectare.....	83.5519	67.3925	145.2546	154.7340
V. <i>Distribution</i>				
A. <i>Landlord</i>				
24. Gross income.....	61.8750	58.4375	42.0200	19.8550
25. Costs.....	25.8798	24.7200	20.5490	25.5367
26. Net income.....	35.9952	33.7175	21.4710	5.6817
27. Net income per cavan.....	1.5998	1.5867	1.4052	.7869
28. Net income per hectare.....	51.4217	40.6233	42.9420	11.3634
29. Investment.....	302.0000	247.5000	149.9508	186.0454
30. Rate of interest on investment.....	.1182	.1362	.1442	.0306
31. Current rate of investment.....	.1200	.1200	.1200	.1200
B. <i>Tenant</i>				
32. Gross income.....	61.8750	58.4375	42.0200	19.8550
33. Costs.....	32.6591	32.1910	52.0783	61.8303
34. Net income.....	29.2159	26.2465	10.0583	41.9753
35. Net income per cavan.....	1.2985	1.2351	.6583	5.8132
36. Net income per hectare.....	41.7374	31.6215	20.1166	83.9506
37. Hours of labor.....	377.3200	294.4150	132.3333	125.0000
38. Income per hour.....	.0771	.0891	.0761	.6779
39. Current wage per hour.....	.0800	.0800	.0800	.0800

Line 10, Seed cost.—Under this head is given the determination of column II.

Line 11, Animal cost.—Under this head is given the determination of column IX, Table III.

Line 12, Implement cost.—Under this head is given the determination of column X, Table III.

Line 13, Supply cost.—Under this head is given the determination of column III, Table IV.

Line 14, Labor cost.—Under this head is given one-half of all amounts in column V, Table VI, for items of harvest labor totaled for each culture.

Line 15, Total cost.—Under this head a determination of the total landlord's cost is arrived at by the addition of lines 9, 10, 11, 12, 13, and 14.

Line 16, Cost per cavan.—The division of line 15 by line 2 determines the landlord's cost per cavan.

Line 17, Cost per hectare.—The multiplication of line 16 by line 5 determines the landlord's cost per hectare.

Tenant's costs

In considering the tenant's cost, reference should be made to page 213, where the agreed method of distribution is described.

Line 18, Outside labor cost.—Under this head is given the determination of column VI, Table VI minus one-half of the total of those items which go to make up the harvest labor cost.

Line 19, Cost per cavan.—The division of line 18 by line 2 determines the tenant's cost per cavan.

Line 20, Cost per hectare.—The multiplication of line 19 by line 5 determines the tenant's cost per hectare.

Total costs

Line 21, Landlord's and Tenant's cost.—The addition of lines 15 and 18 determines the total landlord's and tenant's costs.

Line 22, Total cost per cavan.—The division of line 21 by line 2, determines the total cost per cavan.

Line 23, Total cost per hectare.—The multiplication of line 22 by line 5 determines the total cost per hectare.

Distribution to landlord

In considering the distribution of income to the landlord, reference should be made to page 213, where the method of distribution is described.

Line 24, Gross income.—Taking one-half of line 7 determines the landlord's gross income.

Line 25, Total cost.—Under this head line 15 is repeated.

Line 26, Net income.—The subtraction of line 25 from line 24 determines the landlord's net income.

Line 27, Net income per cavan.—The division of line 26 by line 2 determines the landlord's net income per cavan.

Line 28, Net income per hectare.—The multiplication of line 27 by line 5 determines the landlord's net income per hectare.

Line 29, Investment.—In the case of Maahas and Anos cultures the totals of Table V—A for the Maahas and Anos cultures are here given. In the case of College cultures the totals under column V, Table V—B are here given.

Line 30, Rate of interest on investment.—The division of line 26 by line 29 determines the rate of interest on investment.

Line 31, Current rate of interest.—For purposes of comparison, under this head is given the normal interest charged by legal agencies on well secured farm loans in the vicinity of the survey.

Distribution to tenant

In considering the distribution of income to the tenant, reference should be made to page 213, where the method of distribution is described.

Line 32, Gross income.—This is determined by taking one-half of line 7.

Line 33, Cost.—Under this head line 18 is repeated.

Line 34, Net income.—The subtraction of line 33 from line 32 determines the tenant's net income.

Line 35, Net income per cavan.—The division of line 34 by line 2 determines the tenant's net income per cavan.

Line 36, Net income per hectare.—The multiplication of line 35 by line 5 determines the tenant's net income per hectare.

Line 37, Hours of labor.—In the case of the Maahas culture the number of hours the tenant spent in making the seed bed inspection, supervision, control of water supply and incidental labor is here entered. In the case of the Anos cultures the number of hours the tenant spent in inspection, supervision, control of water supply and incidental labor is here entered. In the case of the College cultures, the total number of hours spent by the writer in inspection, supervision and water control is here entered.

Line 38, Income per hour.—The division of line 34 by line 37 determines the tenant's labor income per hour.

Line 39, Current wage per hour.—For purposes of comparison, under this head is given the hourly wage for agricultural labor. The basis for the determination of this figure is found in the *Boletín de Obrero*, Vol. 1, No. 1, March 1919. To the figures given in this publication, 0.0058 peso was added to offset, as closely as possible, any differential resulting from increase in labor wage subsequent to the date of the publication's calculation.

DISCUSSION OF RESULTS

MAAHAS AND ANOS CULTURES

Limiting the discussion to the Maahas and Anos cultures the following may be noted under Table VII, sections *a* and *b*.

From line 2, it can be seen that the Maahas culture, lowland, produced 22.50 cavanese to the hectare, while the Anos culture, upland, produced 21.25 cavanese, a difference of 1.25 cavanese in favor of the Maahas culture. As a consequence, the Maahas culture yielded the greater gross income.

Line 23 shows that the cost of production per unit area was higher in the Maahas culture than in the Anos culture. The higher cost of production was caused by the higher landlord's cost and tenant's cost per unit area (lines 17 and 20).

Line 15 shows that in the Maahas culture, total landlord's costs was ₱25.8798 and in the Anos culture, ₱24.7200, a difference of ₱1.1598 in favor of the Maahas culture. The higher landlord's cost in the Maahas culture was because the land cost (line 9), seed cost (line 10), animal cost (line 11), and total implement cost (line 12) were higher than in the Anos culture. Line 24 shows that landlord's

income was ₱61.8750 in the Maahas culture, and in the Anos culture ₱58.4375, giving a difference of ₱3.4375 in favor of the Maahas culture; but the landlord's cost (line 25) was ₱25.8798 in the Maahas culture and in the Anos ₱24.7200, so the Maahas landlord had the higher net income (line 26). Line 29 shows that the investment of the landlord in the Maahas culture was ₱302.00 and in the Anos culture ₱247.50. The lower rate of interest (line 30) on the investment of the Maahas landlord was because his investment was much larger than that of the Anos landlord.

As to the tenants, line 18 shows in the Maahas culture, ₱32.6591 as tenant's cost, and in the Anos upland culture, ₱32.1910, giving a difference of ₱0.4681 (line 33) in favor of the Maahas culture, but the tenant in the Maahas culture received ₱0.0774 as hourly income, while the tenant of the Anos culture received ₱0.0891, a difference of ₱0.0117 in favor of the Anos tenant (line 38). This higher income of Anos tenant was because the Maahas tenant put in 377.32 hours while the Anos tenant put in only 294.415 hours, a difference of 82.905 hours (line 37).

From the above results it is seen that the tenant in Anos culture was able to make a profit of ₱0.0091 over the current wage per hour (line 39), while the tenant in Maahas culture lost ₱0.0026 for every hour of his labor on the culture.

COLLEGE UPLAND AND LOWLAND CULTURES

Upon examination of Table VII, Sections *c* and *d*, the following may be observed:

In yield and distribution, no comparison can be drawn between the upland and lowland cultures of the College for the following reasons:

The upland culture was run at a different time than the lowland culture. At the outset of the work it was believed that both cultures would thrive under similar favorable conditions, since it is customary in this locality to plant lowland much later than upland. The upland culture was planted in the height of the rainy season and the lowland at the close of the same season. Contrary to expectation, the upland rice received all the water needed for its normal growth, while the lowland culture suffered from shortage of water at the time of development, as drought set in and an adequate amount of water for the culture could not be furnished by the College irrigation system.

ANOS AND COLLEGE UPLAND CULTURES

From Table VII, sections *b* and *c*, the following comparisons between the Anos upland and College upland cultures may be noted:

1. The Anos culture produced an actual yield of 21.25 cavanese and the College upland 15.28 cavanese, giving a difference of 5.97 cavanese in favor of the Anos culture. This difference in yield resulted in a considerable difference in the gross income (line 7).

2. The cost of production per cavan (line 22) in the College culture was ₱4.7531 and in the Anos culture ₱2.6311, giving a difference of ₱2.1220 in favor of the College culture.

3. In landlord's costs (line 15) the Anos culture involved ₱24.7200 and the College culture ₱20.5490, giving a difference of ₱4.1710 in favor of the Anos upland

culture. This higher landlord cost in the Anos culture was caused by higher seedling costs and higher animal costs, as animals were used exclusively for the cultivation.

4. Tenant's cost (line 18) was ₱52.0783 in the College culture and ₱32.1910 in the Anos culture, giving a difference of ₱19.8873 in favor of the College culture. This higher cost on the part of the tenant of the College was due to the fact that most of the work and harvesting was paid for in cash, which, of course amounted to more than the customary payment in kind.

5. The landlord's net income (line 26) was ₱33.7175 in the Anos culture and ₱21.4710 in the College culture, a difference of ₱12.2465 in favor of the Anos culture.

6. The landlord's investment (line 29) in the Anos culture was ₱247.50 and ₱149.9508 in the College culture, a difference of ₱97.5492; the former's rate of interest on investment (line 30) was 0.1362, as against 0.1442 in the College culture giving a difference of .0080 in favor of the College culture.

7. The tenant's cost (line 33) was ₱32.1910 in the Anos culture and ₱52.0783 in the College culture, a difference of ₱19.8873 in favor of the College culture. The tenant's gross income (line 32) was higher in the Anos culture so the net income (line 34) was also higher. Line 37 shows that the tenant of the College culture put 132.3333 hours on his culture, and the tenant of the Anos culture put 294.4150 hours on his culture, a difference of 162.0817 hours in favor of the Anos culture. Because of the higher net income in favor of the Anos upland culture, the income per hour of the tenant of the Anos culture was ₱0.0891, while in the College culture, the tenant lost ₱.0761 for every hour of his labor. It is shown that the tenant of Anos culture was able to make a profit of ₱.0091 as compared with the current wage per hour (line 39) while the tenant of the College culture lost ₱.1561 for every hour of labor under the same comparison.

CONCLUSIONS

MAAHAS AND ANOS CULTURES

Confining ourselves to the data obtained from Maahas and Anos cultures the results stand as follows:

1. The lowland culture gave a higher yield than the upland culture (line 5).
2. It cost more per unit area to raise lowland rice than upland rice (line 23).
3. It paid to plant upland rice, for both the landlord and the tenant (lines 30 and 38).

4. Defining "profit" as landlord's income over current rate of interest on investment, or tenant's income over current rate of wage per hour, we find that in the lowland culture of Maahas neither the landlord nor the tenant was able to make any profit; but the landlord was better off than the tenant (lines 30 and 38).

5. The landlord and tenant of Anos upland culture were able to make some slight profit (lines 30 and 38).

COLLEGE UPLAND AND LOWLAND CULTURES

Summarizing the results obtained in both the upland and lowland College cultures the following may be noted:

1. No proper comparison can be drawn between the upland and lowland cultures.
2. Land and tenant costs were higher in case of the lowland culture.

ANOS AND COLLEGE UPLAND CULTURES

Comparing the Anos and College upland cultures the following may be observed:

1. The Anos culture gave a higher actual yield (line 2).
2. The College culture produced more per unit of area (line 5).
3. The cost of production per cavan in the College culture was higher (line 22).
4. The landlord's cost in the Anos culture was higher (line 25).
5. The tenant's cost in the Anos culture was lower (line 18 or 33).
6. The landlord's net income in the Anos culture was higher (line 26).
7. The landlord's investment in the College culture was lower (line 29).
8. The landlord of the Anos culture obtained lower rate of interest on investment (line 30).
9. Both of the landlords were able to write off the current interest rate on their investment and have left a small percentage of promoter's profit. But the College landlord received almost twice as much promoter's profit as did the Anos landlord.
10. The tenant's number of hours of labor was less in the College culture than in the Anos culture. This fact accounts for the lower College tenant's income, as any decrease in tenant's hours of labor must be countered by a proportional increase in hours of outside labor, which, in this system of tenantry being chargeable solely to the tenant, must decrease both his net income and his income per hour. In College experimental cultures, where the student confines his tenancy to supervision and hires all weeding and incidental labor, the student, as tenant, will lose.
11. The tenant of the Anos culture was able to attain a wage per hour in excess of the current hourly wage (lines 38 and 39). This excess, however small, represents tenant's promoting profit.

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